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FR-A-1 248 821
GB-A- 853 108
GB-A-1 239 559
GB-A-2 119 861
US-A-3 186 168
US-A-3 670 497
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Description

This invention relates to a gas turbine engine according to th precharacterizing portion of claim 1.

As is well known, the products of combustion delivered to the 1st stage turbine are at the highest temperature that the engine sees. It is equally well-known that engine efficiency is directly related to this temperature and the higher the temperature the more efficient the engine. Obviously, technology dictates that this temperature be as high as the thermal integrity of the component parts will allow and with the advent of higher temperature, resistance alloys these temperatures have been exceedingly high.

In certain engine models, because of the increase in the temperature the component parts in proximity to the turbine/combustor have been experiencing high local metal temperatures resulting in burning, buckling and cracking problems. The problem area in which this invention is directed is best seen in Fig. 1a showing the heretofore assembly. The Fig. 1a is a partial showing of an annular combustor for a twin spool axial flow turbine power plant of the type exemplified by the engine models JT9D, PW2037 and PW4000 manufactured by Pratt & Whitney of United Technologies Corporation.

As noted in Fig. 1A (prior art), the inner and outer louver liners 10 and 12 are suitably attached to the vane supports 14 and 16 which are ultimately tied to the inner case 18 and outer case 20 all in a well-known manner. As is obvious from this construction, the inner and outer louver liners are constrained at the discharge end in a toroidally shaped body and define a passageway for leading the engine's working fluid into the row of vanes 22 (one being shown) to impinge on the turbine blades 24. In this construction and as is apparent from Fig. 1B which is a projected view of Fig. 1A and as shown by the arrows, the cooling air which is introduced from the annular cavity 26 which is fed by the engine's compressor (not shown) is directed toward the critical parts of the vane assembly to assure that these parts withstand the hostile environment.

However, as shown by the arrows in Fig. 1A and the hot spots identified by reference letter A, the problem in this design is caused by high temperature, high velocity of the engines working fluid being displaced by the vane's leading edge 30, and consequently, migrating to the vane platforms 32 and 34 and the burner trailing edge 36 (in proximity to the location of the arrows B).

A gas turbine according to the precharacterizing portion of claim 1 is disclosed in US—A—3 670 497 wherein a support ring for the downstream end of a combustor liner is provided. Slots are formed in the support ring to direct a plurality of closely adjacent cooling air streams over the vane platform surfaces without taking the locations of the turbine vanes int account.

A support means for the downstream end of a combustor liner is also disclosed in US—A—3 186 168. The support means comprises a U-shaped ring having inner and outer corrugated limbs. Cooling air may flow through the corrugations of the inner limb.

Reference is also made to US—A—3 965 066 which discloses a cooling system generally according to the prior art arrangement as shown in Fig. 1A.

Further, GB—A—1 249 559 and DE—B—1 199 541 are concerned with combustors having in the combustor liners air holes for admitting cooling or dilution air substantially radially into the combustion zone upstream of the leading edge of a strut or vane to reduce the temperature of the products of combustion and to provide an impingement cooling effect on the leading edge of the strut or vane.

The object of the invention is to reduce or eliminate the hot spots referred to in the vane platforms and burner trailing edge.

This is achieved by the features of the characterizing portion of claim 1.

We have found that we can obviate the problem stated above by judiciously locating the open-ended channels in the louver trailing edge for receiving cooling air and discreetly impinging it on the leading edge of the adjacent vane. The impingement may be directed to either the vane's outside or inside, but at the stagnation point of the working fluid which is at the vane's leading edge. By injecting this high velocity air directly at the junction of the vane leading edge and the vane platform, the displacement of the hot gas by the vane leading edge into the bounderies of the gas path is substantially attenuated, or even eliminated, thus minimizing the induced vortices illustrated by arrows B. Obviously, this results in a much cooler gas temperature of the boundary layer. Additionally, the channels afford additional heat transfer surface enhancing the convective heat transfer coefficient to further cool the louver trailing edge.

By actual tests, it was found that there was an appreciable reduction in vane platform and burner trailing edge hot spots.

The gas turbine engine will now be described in greater detail with reference to the accompanying drawings which illustrate an embodiment of the invention. In the drawings:

Fig. 1A is a partial view of a turbine type power plant in section showing the combustor/turbine vane assembly exemplifying the prior art construction.

Fig. 1B is a partial projected view of the vane and trailing edge of the burner showing the problem of the heretofore construction.

Fig. 2A is a partial view identical to Fig. 1A but with the invention added.

Fig. 2B is a partial projected view of Fig. 2A, and

Fig. 3 is an obliqu view of the channels located on th trailing edge of the louver liner of Fig. 2A.

While this invention is describ d in the preferr d embodiment for the engine models noted above, as will be obvious to on skilled in the art the invention has applicability to other types of

engines. As is apparent, the problem is to assur that the critical components of the gas turbine engine do not become distressed and particularly the area in proximity to the louver trailing edge and the leading edge of the 1st r w of vanes ahead of the 1st turbine stage (the area where the temperature of the engine is substantially the hottest).

For the sake of convenience and simplicity, only that portion that is necessary to an understanding of the invention will be described, but reference should be made to Figs. 1A and 1B showing the identical structure before the incorporation of the invention together with the model engines identified above and incorporated herein by reference.

As can be seen in Fig. 2A and 2B, the construction of the last louver 40 and trailing edge is modified in accordance with this invention. The louver support member 42 that is supported by the sheet metal attachment 44 connected to vane platform 32 defines an annular cooling chamber 46 which is fed compressor discharge air from cavity 26 through apertures 48 (one being shown). As noted, the trailing edges of louver 40 and louver support member 42 are spaced defining an annular open-ended channel. The discharge end of support member 42 is configured into sinusoidal shaped open-ended channels 50.

As is apparent from the foregoing, the open-ended channels 50 are judiciously located relative to the vanes 22 (see Fig. 2b) so that the cooling air which is at a relatively high velocity is directed toward only the region created by the leading edge and platform of the vanes 22. As was mentioned above, this serves to house the temperature of the boundaries of the hot gas path (fluid working medium) so as to attenuate and even in some instances eliminate the vortices that were induced by the vanes as shown in the prior art design. The incorporation of the channels serve to provide high "back side" convective heat transfer coefficients to further cool the trailing edge of the louver liner.

Claims

1. A gas turbine engine having a combustor, turbine vanes (22) and a turbine axially spaced but adjacent to said turbine vanes (22), said turbine vanes (22) each including an airfoil section and a platform section (32) at the root of said airfoil section, said combustor including louver liners (10, 12) configured to define an annular passageway for directing the products of combustion toward said vanes (22) for ingressing therebetween, a support structure including a sheet member (44) spaced from one of said louver liners (10, 12) and defining therewith a passageway (46) for leading cooling air toward said turbine vanes (22) and over the platform sections (32) thereof forming a cooler boundary layer adjacent said platform sections (32), a corrugated member (42) disposed in said passag way (46) and having blocked portions alternating with spaced open-ended passages (50) for directing said cool air over said platform sections (32), characterized in that said open-ended passages (50) are oriented to impinge the cooling air only and directly at the junction of the leading edge (30) of the turbine vanes (22) and said platforms (32).

2. Gas turbine engine according to claim 1, characterized in that the corrugated member has the blocked portions aligned with the spaces between the vanes (22) and said open-ended passages (50) aligned with the vane leading edges (30).

Patentansprüche

1. Gasturbinentriebwerk mit einer Brennkammer, Turbinenleitschaufeln (22) und einer Turbine in axialem Abstand von, aber benachbart zu den Turbinenleitschaufeln (22), wobei die Turbinenleitschaufeln (22) jeweils einen Flügelprofilabschnitt und einen Plattformabschnitt (32) an dem Fuß des Flügelprofilabschnitts aufweisen, wobei die Brennkammer jalousieartige Flammrohre (10, 12) aufweist, die so ausgebildet sind, daß sie einen ringförmigen Durchlaß zum Leiten der Verbrennungsprodukte zu den Leitschaufeln (22), zwischen denen sie hindurchströmen, begrenzen, eine Tragvorrichtung, die ein Blechteil (44) aufweist, das Abstand von einem der jalousieartigen Flammrohre (10, 12) hat und mit diesem einen Kanal (46) zum Leiten von Kühlluft zu den Turbinenleitschaufeln (22) und über die Plattformabschnitte (32) derselben, um eine kältere Grenzschicht an den Plattformabschnitten (32) zu bilden, und ein gewelltes Teil (42), das in dem Kanal (46) angeordnet ist und blockierte Teile hat, welche mit gegenseitigen Abstand aufweisenden, am Ende offenen Durchlässen (50) zum Leiten der Kühlluft über die Plattformabschnitte (32) abwechseln, dadurch gekennzeichnet, daß die am Ende offenen Durchlässe (50) so ausgerichtet sind, daß die Kühlluft nur und direkt auf die Verbindungsstelle der Vorderkante (30) der Turbinenleitschaufeln (22) und der Plattformen (32) auftritt.

2. Gasturbinentriebwerk nach Anspruch 1, dadurch gekennzeichnet, daß die blockierten Teile des gewellten Teils mit den Zwischenräumen zwischen den Leitschaufeln (22) ausgerichtet sind und daß die am Ende offenen Durchlässe (50) des gewellten Teils mit den Leitschaufelvorderkanten (30) ausgerichtet sind.

Revendications

1. Moteur à turbine à gaz comportant un brûleur, des aubes de turbine (22) et une turbine espacée axialement mais adjacente auxdites aubes de turbine (22), lesdites aubes de turbine (22) comprenant chacune une section transversale d'aube et une section d'intrados (32) à la racine de ladite section transversale de l'aube, ledit brûleur compr nant des chemisages de canaux de ventilation (10, 12) configurés de façon à définir un passage annulaire pour diriger les

pr duits de combustion vers l sdites aubes (22) en vue de p´n´trer entr celles-ci, un structure de support c mprenant un élément en tôle (44) espacé de l'un desdits chemisages d canal d ventilation (10, 12) et définissant avec lui un passage (46) pour conduire l'air de refroifissement vers lesdites aubres de turbine (22) et au-delà des sections d'intrados de celles-ci (32) en formant une couche limite plus froids adjacente auxdites sections d'intrados (32), un élément strié (42) disposé dans ledit passage (46) et présentant des parties fermées alternant avec des passages à extrémité ouverte espacés (50) pour diriger ledit air froid au-dessus desdites sections d'intrados (32) caractérisé en c qu lesdits passages à extrémité ouverte (50) sont orientés pour injecter l'air d refroidissement seulement et directem nt à la jonction du bord d'attaque (30) des aubes de turbine (22) et desdits intrados (32).

2. Moteur à turbine à gaz selon la revendication 1, caractérisé en ce que l'élément strié présente les partie fermées en alignement avec les espaces entre les aubes (22) et lesdits passages à extrémités ouverte en alignement avec les bords d'attaque d'aubes (30).

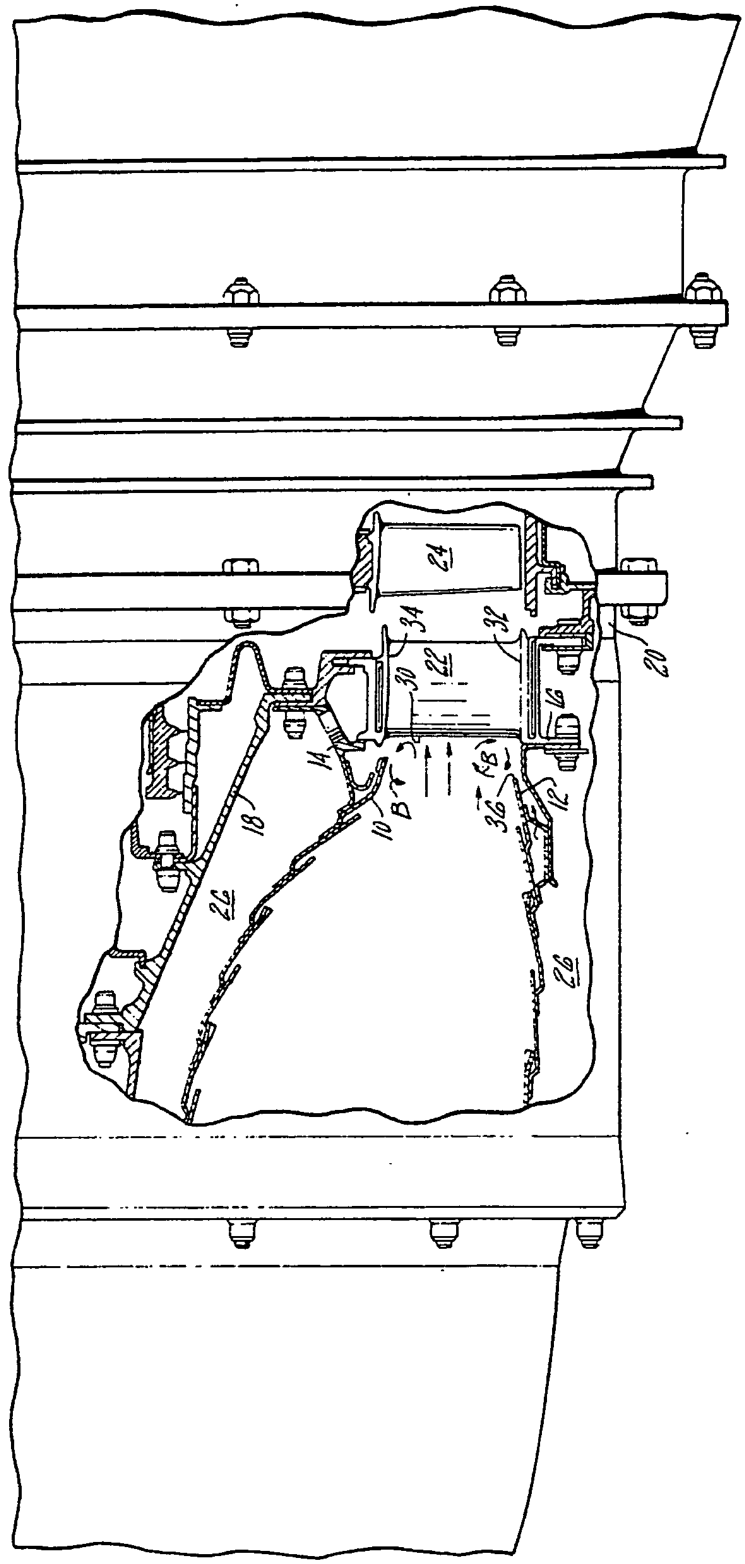
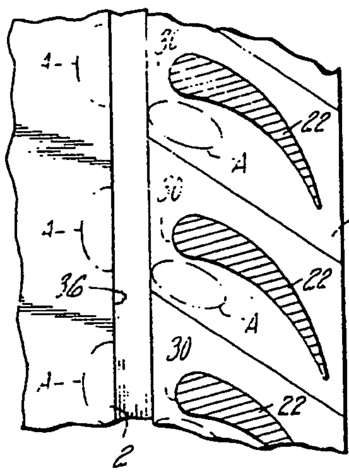


FIG. 1A

FIG. 1B



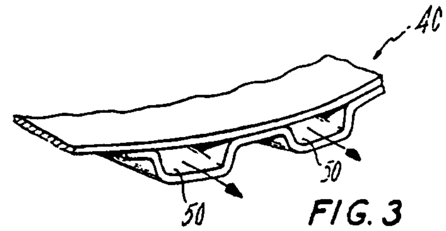
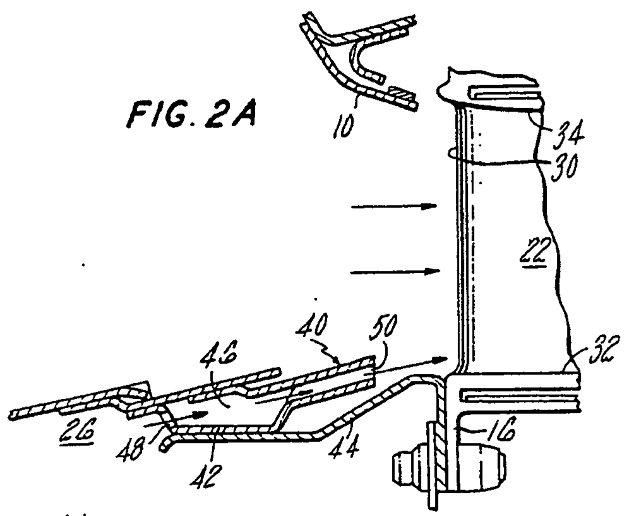


FIG. 3

FIG. 2A



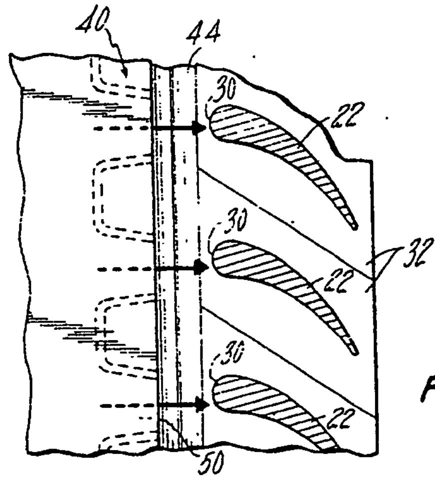


FIG. 2B